SECTION 13401--PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS)

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A182	Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A276	Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A312	Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes
ASTM B32	Standard Specification for Solder Metal
ASTM B88	Standard Specification for Seamless Copper Water Tube

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA S5.1	Instrumentation Symbols and Identification (NRC ADOPTED)
ISA S50.1	Compatibility of Analog Signals for Electronic Industrial Process Instruments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1,000 Volts Maximum)
NEMA ICS 1	General Standards for Industrial Control and Systems

SUMMARY:

Work Includes:

The subcontractor shall furnish and install all material and labor to accomplish the design as depicted by the Construction Documents. The Contractor shall provide all material and hardware necessary to achieve the required function whether it is called for or not. This also includes, but is not limited to, all testing, all calibration, all adjustment, all startup, all training, and all documentation pertaining to the PICS system.

Major components and controls to integrate into PICS and program include:

Landfill Crest Pad Building Control Panel, PLC, and Operator Interface.

Evaporator Pond(s) Crest Building Control Panel, PLC, and Operator Interface.

Landfill Leachate Collection and Detection and Recovery System Pump Control.

Landfill Leachate Collection and Detection and Recovery System Pump Discharge Flow and Flow Totalization.

Landfill Leachate Collection and Recovery System Continuous Level Measurement.

Landfill Leak Detection and Recovery System Continuous Level Measurement.

Evaporator Pond(s) Leak Detection and Recovery System Continuous Level Measurement.

Carrier Pipe and Manhole Leak Detection Chamber Discrete Level Measurement.

Landfill Crest Pad Building Sump Discrete Level Measurement.

Evaporator Pond(s) Crest Pad Building Sump Discrete Level Measurement.

Interlock Control between Crest Pad Building Sump and Leachate Collection and Leak Detection and Recovery System Pump Controls

Landfill Crest Pad Building Continuous Temperature Measurement.

Evaporation Pond(s) Crest Pad Building Continuous Temperature Measurement.

Landfill Crest Pad Building Discrete Power Measurement.

Evaporation Pond(s) Crest Pad Building Discrete Power Measurement.

Landfill Crest Pad Building Discrete Smoke Detection.

Evaporation Pond(s) Crest Pad Building Discrete Smoke Detection.

DEFINITIONS:

Abbreviations:

LCP: Local Control Panel.

MCC: Motor Control Center.

OIU: Operator Interface Unit.

PAT: Performance Acceptance Test.

PLC: Programmable Logic Controller.

SLC: Small Programmable Logic Controller.

Rising/Falling: Terms used to define actions of discrete devices about their set points.

Rising: Contacts change state when an increasing process variable rises through set point.

Falling: Contacts change state when a decreasing process variable falls through set point.

Signal Types:

Analog Signals, Current Type:

4 to 20 mA dc signals conforming to ISA S50.1.

Unless otherwise indicated for specific PICS Subsystem components, use the following ISA 50.1 options:

Transmitter Type: Number 2, two-wire.

Transmitter Load Resistance Capacity: Class L.

Fully isolated transmitters and receivers.

Analog Signals, Voltage Type: 1 to 5 volts dc within control panels only.

Discrete signals, two-state logic signals using dc or 120V ac sources as indicated.

Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

Instrument Tag Numbers: In accordance with DOE-ID Architectural Standards.

DELIVERY, STORAGE, AND HANDLING:

Provide site and warehouse storage facilities for PICS equipment.

Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers, and related equipment as recommended by the capsule manufacturer.

Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.

Cover panels and other elements that are exposed to dusty construction environments.

ENVIRONMENTAL REQUIREMENTS:

Standard Environmental Requirements: Unless otherwise noted, provide equipment for continuous operation in these environments:

Freestanding Panel and Consoles:

Inside: NEMA 12.

Smaller Panels and Assemblies (that are not Freestanding):

Inside: NEMA 12.

All Other Locations: NEMA 4X.

Field Elements: Outside.

Special Environmental Requirements: Design panels for continuous operation in environments listed:

Building Sump Power Local Control Panel LCP-CD-940 to be installed inside the INEEL CERCLA Landfill Crest Pad Building.

Building Sump Control Local Control Panel LCP-CD-941 to be installed inside the INEEL CERCLA Landfill Crest Pad Building.

Building Sump Local Control Panel LCP-CD-942 to be installed inside the INEEL CERCLA Evaporation Ponds Crest Pad Building.

Combined Sump Local Control Panel LCP-CD-943 to be installed inside the INEEL CERCLA Evaporation Ponds Crest Pad Building.

Control Panel CP-CD-950 to be installed inside the INEEL CERCLA Landfill Crest Pad Building.

Control Panel CP-CD-951 to be installed inside the INEEL CERCLA Evaporation Ponds Crest Pad Building.

Environmental Design Requirements: Environmental conditions are defined below:

Inside:

Temperature: 10 to 30 degrees C.

Relative Humidity: 15 to 90 percent noncondensing.

NEC Classification: Nonhazardous.

Outside:

Temperature: Minus 40 to 40 degrees C.

Relative Humidity: 15 to 90 percent noncondensing.

NEC Classification: Nonhazardous.

Snow Accumulation: 48 inches.

PART 2--PRODUCTS

GENERAL:

The general functions of the PICS are as depicted on the Drawings. The PICS contractor shall provide a full-featured system that is complete, calibrated, and fully operational.

Like Equipment Items:

Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.

Implement all same or similar functions in same or similar manner. For example, control logic, sequence controls, and display layouts.

I&C COMPONENTS:

Components for Each Loop: Major components for each loop are listed in Instrument List referenced in Article SUPPLEMENTS. Furnish all equipment that is necessary to achieve required loop performance.

Component Specifications: Generalized specifications for each type of component are located in Article SUPPLEMENTS.

NAMEPLATES AND TAGS:

Panel Nameplates: Enclosure identification located on the enclosure face.

Location and Inscription: As shown.

Materials: Laminated plastic attached to panel with stainless steel screws.

Letters: 1/2-inch white on black background, unless otherwise noted.

Component Nameplates—Panel Face: Component identification located on panel face under or near component.

Location and Inscription: As shown.

Materials: Laminated plastic attached to panel with stainless steel screws.

Letters: 3/16-inch white on black background, unless otherwise noted.

Component Nameplates—Back of Panel: Component identification located near component inside of enclosure.

Inscription: Component tag number.

Materials: Adhesive backed, laminated plastic.

Letters: 3/16-inch white on black background, unless otherwise noted.

Legend Plates for Panel Mounted Pushbuttons, Lights, and Switches:

Inscription: Refer to:

Table under paragraph Standard Pushbutton Colors and Inscriptions.

Table under paragraph Standard Light Colors and Inscriptions.

P&IDs in Drawings.

Materials: Engraved plastic, keyed legend plates. Secured to panel by mounting nut for pushbutton, light, or switch.

Letters: Black on gray or white background.

Service Legends: Component identification nameplate located on face of component.

Inscription: As shown.

Materials: Adhesive backed, laminated plastic.

Letters: 3/16-inch white on black background, unless otherwise noted.

Nametags: Component identification for field devices.

Inscription: Component tag number.

Materials: 16-gauge, Type 304 stainless steel.

Letters: 3/16-inch imposed.

Mounting: Affix to component with 16- or 18-gauge stainless steel wire or stainless steel screws.

ELECTRICAL REQUIREMENTS:

In accordance with Division 16, ELECTRICAL.

I&C and electrical components, terminals, wires, and enclosures: UL recognized or UL listed.

Wires Within Enclosures:

ac Circuits:

Type: 600-volt, Type SIS stranded copper.

Size: For current to be carried, but not less than No. 14 AWG.

Analog Signal Circuits:

Type: 600-volt stranded copper, twisted shielded pairs.

Size: No. 16 AWG, minimum.

Other dc Circuits:

Type: 600-volt, Type SIS stranded copper.

Size: For current carried, but not less than No. 18 AWG.

Special Signal Circuits: Use manufacturer's standard cables.

Wire Identification: Numbered and tagged at each termination.

Wire Tags: Snap-on or slip-on PVC wire markers with legible machine printed markings and numbers. Adhesive or taped-on tags are not acceptable.

Wires entering or leaving enclosures, terminate and identify as follows:

Analog and discrete signal, terminate at numbered terminal blocks.

Special signals, terminated using manufacturer's standard connectors.

Identify wiring in accordance with Section 16120, CONDUCTORS.

Terminal Blocks for Enclosures:

Wire spare PLC I/O points to terminal blocks.

One wire per terminal for field wires entering enclosures.

Maximum of two wires per terminal for 18-WG wire for internal enclosure wiring.

Spare Terminals: 20 percent of all connected terminals, but not less than 5 per terminal block.

General:

Connection Type: Screw compression clamp.

Compression Clamp:

Complies with DIN-VDE 0611.

Hardened steel clamp with transversal groves that penetrate wire strands providing a vibration-proof connection.

Guides strands of wire into terminal.

Screws: Hardened steel, captive and self-locking.

Current Bar: Copper or treated brass.

Insulation:

Thermoplastic rated for minus 55 to plus 110 degree C.

Two funneled shaped inputs to facilitate wire entry.

Mounting:

Standard DIN rail.

Terminal block can be extracted from an assembly without displacing adjacent blocks.

End Stops: Minimum of one at each end of rail.

Wire Preparation: Stripping only permitted.

Jumpers: Allow jumper installation without loss of space on terminal or rail.

Marking System:

Terminal number shown on both sides of terminal block.

Allow use of preprinted and field marked tags.

Terminal strip numbers shown on end stops.

Mark terminal block and terminal strip numbers as shown on Panel Control Diagrams and Loop Diagrams.

Terminal Block, General-Purpose:

Rated Voltage: 600V ac.

Rated Current: 30 amp.

Wire Size: No. 22 to No. 10 AWG.

Rated Wire Size: No. 10 AWG.

Color: Grey body.

Spacing: 0.25 inch, maximum.

Test Sockets: One screw test socket 0.079-inch diameter.

Manufacturer and Product: Entrelec; Type M4/6.T.

Terminal Block, Ground:

Wire Size: No. 22 to No. 12 AWG.

Rated Wire Size: No. 12 AWG.

Color: Green and yellow body.

Spacing: 0.25 inch, maximum.

Grounding: Ground terminal blocks electrically grounded to the mounting rail.

Manufacturer and Product: Entrelec; Type M4/6.P.

Terminal Block, Blade Disconnect Switch:

Rated Voltage: 600V ac.

Rated Current: 10-amp.

Wire Size: No. 22 to No. 12 AWG.

Rated Wire Size: No. 12 AWG.

Color: Grey body, orange switch.

Spacing: 0.25 inch, maximum.

Manufacturer and Product: Entrelec; Type M4/6.SN.T.

Terminal Block, Fused, 24V dc:

Rated Voltage: 600V dc.

Rated Current: 16-amp.

Wire Size: No. 22 to No. 10 AWG.

Rated Wire Size: No. 10 AWG.

Color: Grey body.

Fuse: 0.25 inch by 1.25 inch.

Indication: LED diode 24V dc.

Spacing: 0.512 inch, maximum.

Manufacturer and Product: Entrelec; Type M10/13T.SFL.

Terminal Block, Fused, 120V ac:

Rated Voltage: 600V ac.

Rated Current: 16-amp.

Wire Size: No. 22 to No. 10 AWG.

Rated Wire Size: No. 10 AWG.

Color: Grey body.

Fuse: 0.25 inch by 1.25 inch.

Indication: Neon Lamp 110V ac.

Leakage Current: 1.8 mA, maximum.

Spacing: 0.512 inch, maximum

Manufacturer and Product: Entrelec; Type M10/13T.SFL.

Terminal Block, Fused, 120V ac, High Current:

Rated Voltage: 600V ac.

Rated Current: 35 amps.

Wire Size: No. 18 to No. 8 AWG.

Rated Wire Size: No. 8 AWG.

Color: Grey.

Fuse: 13/32 inch by 1.5 inch.

Spacing: 0.95 inch, maximum.

Manufacturer and Product: Entrelec; Type MB10/24.SF.

Grounding of Enclosures:

Furnish copper isolated ground bus. Take car to ensure that this bus is connected to the safety ground bus at only one point.

Single Point Ground for Each Analog Loop:

Group and connect shields in following locations:

Control Panel.

Ground terminal block rails to ground bus.

Analog Signal Isolators: Furnish signal isolation for analog signals that are sent from one enclosure to another and where required to provide proper function. Do not wire in series instruments on different panels, cabinets, or enclosures.

Power Distribution Within Panels:

Feeder Circuits:

One or more 120V ac, 60-Hz feeder circuits as shown on Drawings.

Make provisions for feeder circuit conduit entry.

Furnish terminal blocks for termination of wires.

Power Panel: Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.

Locate to provide clear view of and access to breakers when door is open.

Breaker Sizes: Coordinate such that fault in branch circuit will blow only branch breaker but not trip the main breaker.

Branch Circuit Breaker: Select size of circuit breaker to suit load at 250V ac.

Breaker Manufacturers and Products: Allen-Bradley 1492-GH.

Circuit Wiring: P&IDs and Control Diagrams on Drawings show function only. Use following rules for actual circuit wiring:

Devices on Single Circuit: 20, maximum.

Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.

Branch Circuit Loading: 12 amperes continuous, maximum.

Panel Lighting and Service Outlets: Put on separate 15-amp, 120V ac branch circuit.

Provide 120-volt ac plugmold for panel components with line cords.

Signal Distribution:

Within Panels: 4 to 20 mA dc signals may be distributed as 1 to 5V dc.

Outside Panels: Isolated 4 to 20 mA dc only.

All signal wiring in twisted shielded pairs.

Signal Switching:

Use dry circuit type relays or switches.

No interruption of 4 to 20 mA loops during switching.

Switching Transients in Associated Signal Circuit:

4 to 20 mA dc Signals: 0.2 mA, maximum.

1 to 5V dc Signals: 0.05V, maximum.

Relays:

General:

Relay Mounting: Plug-in type socket.

Relay Enclosure: Furnish dust cover.

Socket Type: Screw terminal interface with wiring.

Socket Mounting: Rail.

Provide holddown clips.

Control Circuit Switching Relay, Nonlatching:

Type: Compact general-purpose plug-in.

Contact Arrangement: 3 Form C contacts.

Contact Rating: 10A at 28V dc or 240V ac.

Contact Material: Silver cadmium oxide alloy.

Coil Voltage: As noted or shown.

Coil Power: 1.2 watts (dc), 1.75VA (ac).

Expected Mechanical Life: 10,000,000 operations.

Expected Electrical Life at Rated Load: 100,000 operations.

Indication Type: Neon or LED indicator lamp.

Push to test button.

Manufacturer and Product: Allen-Bradley; 700-HA Series.

For all 11-pin relays use Allen-Bradley 700-HN203. For 8-pin relays, use Allen-Bradley 700-HN203.

Control Circuit Switching Relay, Latching:

Type: Dual coil mechanical latching relay.

Contact Arrangement: 2 Form C contacts.

Contact Rating: 10A at 28V dc or 120V ac.

Contact Material: Silver cadmium oxide alloy.

Coil Voltage: As noted or shown.

Coil Power: 2.7 watts (dc), 5.3VA (ac).

Expected Mechanical Life: 500,000 operations.

Expected Electrical Life at Rated Load: 50,000 operations.

Manufacturer and Product: Potter and Brumfield; Series KB/KBP.

Control Circuit Switching Relay, Time Delay:

Type: Adjustable time delay relay.

Contact Arrangement: 3 Form C contacts.

Contact Rating: 10A at 240V ac.

Contact Material: Silver cadmium oxide alloy.

Coil Voltage: As noted or shown.

Operating Temperature: Minus 10 to 55 degrees C.

Repeatability: Plus or minus 0.5 percent.

Timing Module: Solid state multifunction plug-in module. Plugs into socket to add timing feature to general purpose relay.

Manufacturer and Products: Allen-Bradley 700-HT1 for ac, 700-HT2 for dc.

Power Supplies:

Furnish to power instruments requiring external dc power, including two-wire transmitters and dc relays.

Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with plus or minus 0.05 percent voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.

Provide output over voltage and over current protective devices to:

Protect instruments from damage due to power supply failure.

Protect power supply from damage due to external failure.

Enclosures: NEMA 1 in accordance with NEMA 250.

Mount such that dissipated heat does not adversely affect other components.

Fuses: For each dc supply line to each individual two-wire transmitter.

Type: Indicating.

Mount so fuses can be easily seen and replaced.

Resistors: All resistors used to derive a 1-5V dc signal from a 4-20 mA dc signal shall be 250 ohm, ±1 percent, 3 watts, axial lead, non-inductive wire wound, welded construction, silicone coated, 1,000V ac dielectric. Vishay-Dale RS-2B-NS or equal. 250 ohms is a standard value in this line, and use of a resistance other that 250 ohms is not acceptable.

Internal Panel Lights for Freestanding Panels:

Type: Switched 100-watt fluorescent back-of-panel lights.

Quantity: One light for every 4 feet of panel width.

Mounting: Inside and in the top of back-of-panel area.

Protective metal shield for lights.

Service Outlets for Freestanding Panels:

Type: Three-wire, 120-volt, 15-ampere, GFI duplex receptacles.

Quantity:

For Panels 4 Feet Wide and Smaller: One.

For Panels Wider Than 4 Feet: One for every 4 feet of panel width, two minimum per panel.

Mounting: Evenly spaced along back-of-panel area.

Standard Pushbutton Colors and Inscriptions: Use following color code and inscriptions for pushbuttons, unless otherwise noted in Instrument List, Article SUPPLEMENTS.

Tag Function	Inscription(s)	Color
OO	ON	Red
	OFF	Green
OC	OPEN	Red
	CLOSE	Green
OCA	OPEN	Red
	CLOSE	Green
	AUTO	White
OOA	ON	Red
	OFF	Green
	AUTO	White
MA	MANUAL	Yellow
	AUTO	White
SS	START	Red
	STOP	Green
RESET	RESET	Red
EMERGENCY STOP	EMERGENCY STOP	Red

Unused or Noninscribed Buttons: Black.

Standard Light Colors and Inscriptions: The following table gives the inscriptions for service legends, and the lens colors for indicating lights.

Tag Function	Inscription(s)	Color
ON	ON	Red
OFF	OFF	Green
OPEN	OPEN	Red
CLOSED	CLOSED	Green
LOW	LOW	Green
FAIL	FAIL	Amber
HIGH	HIGH	Red
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow

Lettering Color:

Black on white and amber lenses.

White on red and green lenses.

FABRICATION:

General:

Panels with external dimensions and instruments arrangement as shown on Drawings.

Panel Construction and Interior Wiring: In accordance with the National Electrical Code, state and local codes, NEMA, ANSI, UL, and ICECA.

Fabricate panels, install instruments, wire, and plumb, at the PICS factory.

Electrical Work: In accordance with Division 16, ELECTRICAL.

Shop Assembly: No panel assembly other than correction of minor defects or minor transit damage shall be done on panels at site.

UL Label for Enclosures: UL label stating "Listed Enclosed Industrial Control Panel."

Wiring Within PICS Panels:

Routed through slotted PVC wiring duct with mating cover.

Hinge Wiring: Secure at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.

Arrange wiring neatly, cut to proper length, and remove surplus wire.

Abrasion protection for wire bundles, which pass through holes or across edges of sheet metal.

Connections to Screw Type Terminals:

Locking-fork-tongue or ring-tongue lugs.

Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations and to avoid crossovers at a 90-degree angle.

Wires terminated in a crimp lug, maximum of one.

Lugs installed on a screw terminal, maximum of two.

Connections to Compression Clamp Type Terminals:

Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.

Wires installed in a compression screw and clamp, maximum of one for field wires entering enclosure, otherwise maximum of two, or quantity as approved by manufacturer.

Splicing and tapping of wires, allowed only at device terminals or terminal blocks.

Terminate 24V dc and analog terminal blocks separate from 120V ac circuit terminal blocks.

Separate analog and dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.

Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.

Plastic Wire Ducts Fill: Do not exceed manufacturer's recommendation.

Temperature Control:

Freestanding Panels:

Nonventilated Panels: Size to adequately dissipate heat from equipment mounted inside panel or on panel.

Ventilated Panels:

Provide all ventilated panels with louvers and fans with filters or other cooling means as required to maintain internal temperature between 40 degrees F to 90 degrees F.

For panels with backs against wall, furnish louvers on top and bottom of panel sides.

For panels without backs against wall, furnish louvers on top and bottom of panel back.

Louver Construction: Stamped sheet metal.

Ventilation Fans:

Furnish where required to provide adequate cooling.

Create positive internal pressure within panel.

Fan Motor Power: 120 volt, 60-Hz ac, thermostatically controlled.

Air Filters: Washable aluminum, Hoffman Series A-FLT.

Refrigerated System: Furnish where heat dissipation cannot be adequately accomplished with natural convection or forced ventilation. Smaller Panels (that are not freestanding): Size to adequately dissipate heat from equipment mounted inside panel or in panel face.

Freestanding Panel Construction:

Materials: Sheet steel, unless otherwise shown on Drawings with minimum thickness of 12-gauge, unless otherwise noted.

Panel Fronts:

Fabricated from a single piece of sheet steel, unless otherwise shown on Drawings.

No seams or bolt heads visible when viewed from front.

Panel Cutouts: Smoothly finished with rounded edges.

Stiffeners: Steel angle or plate stiffeners or both on back of panel face to prevent panel deflection under instrument loading or operation.

Internal Framework:

Structural steel for instrument support and panel bracing.

Permit panel lifting without racking or distortion.

Lifting rings to allow simple, safe rigging and lifting of panel during installation.

Adjacent Panels: Securely bolted together so front faces are parallel.

Doors: Full height, fully gasketed access doors where shown on Drawings.

Latches: Three-point, Southco Type 44.

Handles: "D" ring, foldable type.

Hinges: Full length, continuous, piano type, steel hinges with stainless steel pins.

Rear Access Doors: Extend no further than 24 inches beyond panel when opened to 90-degree position.

Front and Side Access Doors: As shown on Drawings.

Nonfreestanding Panel Construction:

Based on environmental design requirements required and referenced in Article ENVIRONMENTAL REQUIREMENTS, provide the following:

For panels listed as inside:

Enclosure Type: NEMA 12 in accordance with NEMA 250.

Materials: Steel.

For all other panels:

Enclosure Type: NEMA 4X in accordance with NEMA 250.

Materials: Type 316 stainless steel.

Metal Thickness: 14-gauge, minimum.

Doors:

Rubber-gasketed with continuous hinge.

Stainless steel lockable quick-release clamps.

Manufacturers:

Hoffman Engineering Co.

H. F. Cox.

Factory Finishing:

Enclosures:

Stainless Steel and Aluminum: Not painted.

Nonmetallic Panels: Not painted.

Steel Panels:

Sand panel and remove mill scale, rust, grease, and oil.

Fill imperfections and sand smooth.

Prepare metal and paint panel interior and exterior with one coat of epoxy coating metal primer, two finish coats of two-component type epoxy enamel.

Sand surfaces lightly between coats.

Dry Film Thickness: 3 mils, minimum.

Color: Light gray.

Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with light gray color.

CORROSION PROTECTION:

Corrosion-Inhibiting Vapor Capsule Manufacturers:

Northern Instruments; Model Zerust VC.

Hoffmann Engineering Co; Model A-HCI.

PART 3--EXECUTION

EXAMINATION:

For equipment not provided by PICS, but that directly interfaces with the PICS, verify the following conditions:

Proper installation.

Calibration and adjustment of positioners and I/P transducers.

Correct control action.

Switch settings and dead bands.

Opening and closing speeds and travel stops.

Input and output signals.

Report discrepancies to the Construction Manager and the contractor furnishing the material.

INSTALLATION:

Material and Equipment Installation: Retain a copy of manufacturers' instructions at site, available for review at all times.

Electrical Wiring: As specified in Division 16, ELECTRICAL

Removal or Relocation of Materials and Equipment:

Remove from site materials that were part of the existing facility but are no longer used, unless otherwise directed by Construction Subcontractor to deliver to Contractor.

Repair affected surfaces to conform to type, quality, and finish of surrounding surface.

TRAINING:

General:

Provide an integrated training program to meet specific needs of Contractor's personnel.

Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.

Provide instruction on two working shifts as needed to accommodate the Contractor's personnel schedule.

Contractor reserves the right to make and reuse videotapes of training sessions.

Provide reference handouts that cover the course content for all personnel attending any course or training session.

Operations and Maintenance Training:

Include a review of O&M manuals and survey of spares, expendables, and test equipment.

Use equipment similar to that provided or currently owned by Contractor.

Provide training suitable for instrument technicians with at least a 2-year associate engineering or technical degree, or equivalent education and experience in electronics or instrumentation.

Operations Training:

Training Session Duration: One 8-hour instructor days.

Number of Training Sessions: Two.

Location: Site.

Content: Conduct training on loop-by-loop basis.

Loop Functions: Understanding of loop functions, including interlocks for each loop.

Loop Operation: For example, adjusting process variable set points, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.

Interfaces with other control systems.

Maintenance Training:

Training Session Duration: One 8-hour instructor days.

Number of Training Sessions: One.

Location: Project site.

Content: Provide training for each type of component and function provided.

Loop Functions: Understanding details of each loop and how they function.

Component calibration.

Adjustments: For example, controller-tuning constants, current switch trip points, and similar items.

Troubleshooting and diagnosis for components.

Replacing lamps, fuses.

Component removal and replacement.

Periodic maintenance.

CLEANING/ADJUSTING:

Repair affected surfaces to conform to type, quality, and finish of surrounding surface.

Cleaning:

Prior to closing system using tubing, clear tubing of interior moisture and debris.

Upon completion of Work, remove materials, scraps, and debris from interior and exterior of equipment.

PROTECTION:

Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.

Periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules just prior to Final Payment and Acceptance.

SUPPLEMENTS:

Supplements listed below, following "END OF SECTION," are part of this Specification.

Supplement 1—Instrument List.

Supplement 2—PLC Input and Output List.

Supplement 3—Instrument Calibration Sheet: Provides detailed information on each instrument (except simple hand switches, lights, and similar items). To be filled out under this section.

Supplement 4—I&C Valve Adjustment Sheet: Each sheet shows detailed information for installation, adjustment, and calibration of a given valve. To be filled out under this section.

Supplement 5—Performance Acceptance Test Sheet: Describes the PAT for a given loop. The format is mostly free form.

Lists the requirements of the loop.

Briefly describes the test.

Cites expected results.

Provides space for check off by witness.

END OF SECTION 13401

INSTRUMENT LIST

Item	Rev	Tag 1	Tag2	Tag3	Description	Description	P&ID	Manufacturer	Model Number	Additional Information	Options	Comments
		ISA	Process	Loop								
1	0	FT	CD	203-1	Landfill Leachate Collection and Recovery System High Flow Pump	Flow Propeller Transmitter	IN-201	Provided by leachate collection pump vendor				
2	0	FI	CD	203-1	Landfill Leachate Collection and Recovery System High Flow Pump	Flow Indicator	IN-201	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
3	0	FT	CD	203-2	Landfill Leachate Collection and Recovery System Low Flow Pump	Flow Propeller Transmitter	IN-201	Provided by leachate collection pump vendor				
4	0	FI	CD	203-2	Landfill Leachate Collection and Recovery System Low Flow Pump	Flow Indicator	IN-201	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
5	0	FT	CD	204	Landfill Leak Detection and Recovery System Pump	Flow Propeller Transmitter	IN-201	Provided by leachate collection pump vendor				
6	0	FI	CD	204	Landfill Leak Detection and Recovery System Pump	Flow Indicator	IN-201	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
7	0	FT	CD	208	Landfill Secondary Leak Detection and Recovery System Pump	Flow Propeller Transmitter	IN-201	Provided by leachate collection pump vendor				
8	0	FI	CD	208	Landfill Secondary Leak Detection and Recovery System Pump	Flow Indicator	IN-201	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
9	0	LT	CD	103	Landfill Leachate Collection and Recovery System	Submersible Pressure Transducer	IN-201	Provided by leachate collection pump vendor				
10	0	LI	CD	103	Landfill Leachate Collection and Recovery System	Level Indicator	IN-201	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
11	0	LT	CD	104	Landfill Leak Detection and Recovery System	Submersible Pressure Transducer	IN-201	Provided by leachate collection pump vendor				
12	0	LI	CD	104	Landfill Leak Detection and Recovery System	Level Indicator	IN-201	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
13	0	LT	CD	108	Landfill Secondary Leak Detection and Recovery System	Submersible Pressure Transducer	IN-201	Provided by leachate collection pump vendor				
14	0	LI	CD	108	Landfill Secondary Leak Detection and Recovery System	Level Indicator	IN-201	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
15	0	TT	CD	1799	Landfill Crest Pad Building	Temperature Transmitter	IN-201	Rosemount	Model 3144-D-1-NA-X1	Series 68 RTD with spring loaded thermowell		Pipe Mount
16	0	-	-	-	Spare	Spare	IN-201	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
17	0	LSH	CD	105	Landfill Crest Pad Building Sump High	Level Float	IN-201	Gems Sensors	LS-700 Series Buna N 39049	Type 1 Mounting Stem		Group 1 Wiring
18	0	LSHH	CD	105	Landfill Crest Pad Building Sump High High	Level Float	IN-201	Gems Sensors	LS-700 Series Buna N 39049	Type 1 Mounting Stem		Group 1 Wiring
77	0	LSL	CD	105	Landfill Crest Pad Building Sump Low	Level Float	IN-201	Gems Sensors	LS-700 Series Buna N 39049	Type 1 Mounting Stem		Group 1 Wiring
19	0	LCP	CD	941	Landfill Crest Pad Building Sump Panel	Enclosure	IN-201	Hoffman	A-161206LP	Type 12 Wall Mount		Provide devices as shown
20	0	JSH	CD	1799	Landfill Crest Pad Building	Power Relay	IN-201	Allen Bradley				
21	0	ZS	CD	1799	Landfill Crest Pad Building	Door Intrusion Switch	IN-201	Square-D	Class 9007 Type C54B2	Level Arm MA-11		10 Degree Movement
22	0	YL	CD	1799	Landfill Crest Pad Building	Alarm Light	IN-201	Edwards	Adaptabeacon 52R-N5-40W			Rotating Lens outdoor pipe mount
23	0	LT	CD	102	Evaporation East Pond Leak Detection and Recovery System	Submersible Pressure Transducer	IN-202	Provided by leachate collection pump vendor				
24	0	LI	CD	102	Evaporation East Pond Leak Detection and Recovery System	Level Indicator	IN-202	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
25	0	LT	CD	101	Evaporation West Pond Leak Detection and Recovery System	Submersible Pressure Transducer	IN-202	Provided by leachate collection pump vendor				
26	0	LI	CD	101	Evaporation West Pond Leak Detection and Recovery System	Level Indicator	IN-202	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
27	0	FT	CD	207	Evaporation Pond Combined Sump	Flow Propeller Transmitter	IN-202	Provided by leachate collection pump vendor				
28	0	FI	CD	207	Evaporation Pond Combined Sump	Flow Indicator	IN-202	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
29	0	FT	CD	327	Evaporation Pond Truck Loading/Unloading	Flow Propeller Transmitter	IN-202	Provided by leachate collection pump vendor				
30	0	FI	CD	327	Evaporation Pond Truck Loading/Unloading	Flow Indicator	IN-202	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
31	0	FT	CD	330	Evaporation Pond Wastewater from SSSTF	Flow Propeller Transmitter	IN-202	Provided by leachate collection pump vendor				
32	0	FI	CD	330	Evaporation Pond Wastewater from SSSTF	Flow Indicator	IN-202	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
33	0	TT	CD	1798	Evaporation Pond(s) Crest Pad Building	Temperature Transmitter	IN-202	Rosemount	Model 3144-D-1-NA-X1	Series 68 RTD with spring loaded thermowell		Pipe Mount
34	0	-	-	-	Spare	Spare	IN-201	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power

INSTRUMENT LIST

Item	Rev	Tag 1	Tag2	Tag3	Description	Description	P&ID	Manufacturer	Model Number	Additional Information	Options	Comments
		ISA	Process	Loop								
35	0	LSH	CD	106	Evaporation Pond(s) Crest Pad Building Sump High	Level Float	IN-202	Gems Sensors	LS-700 Series Buna N 39049	Type 1 Mounting Stem		Group 1 Wiring
36	0	LSHH	CD	106	Evaporation Pond(s) Crest Pad Building Sump High High	Level Float	IN-202	Gems Sensors	LS-700 Series Buna N 39049	Type 1 Mounting Stem		Group 1 Wiring
37	0	LCP	CD	942	Evaporation Pond(s) Crest Pad Building Sump Panel	Enclosure	IN-202	Hoffman	A-161206LP	Type 12 Wall Mount		Provide devices as shown
38	0	JSH	CD	1798	Evaporation Pond(s) Crest Pad Building	Power Relay	IN-202					
39	0	LSH	CD	499	Landfill Leachate Transmission Line Leak Detection	Level Float	IN-202	Gems Sensors	LS-700 Series Buna N 39049	Type 1 Mounting Stem		Group 1 Wiring
40	0	ZS	CD	1798	Evaporation Pond(s) Crest Pad Building	Door Intrusion Switch	IN-202	Square-D	Class 9007 Type C54B2	Level Arm MA-11		10 Degree Movement
41	0	YL	CD	1798	Evaporation Pond(s) Crest Pad Building	Alarm Light	IN-201	Edwards	Adaptabeacon 52R-N5-40W			Rotating Lens outdoor pipe mount
42	0	LSH	CD	107	Evaporation Pond(s) Combined Sump High	Level Float	IN-202	Gems Sensors	LS-700 Series Buna N 39049	Type 1 Mounting Stem		Group 1 Wiring
43	0	LSHH	CD	107	Evaporation Pond(s) Combined Sump High High	Level Float	IN-202	Gems Sensors	LS-700 Series Buna N 39049	Type 1 Mounting Stem		Group 1 Wiring
44	0	LSL	CD	107-1	Evaporation Pond(s) Combined Sump Low	Level Float	IN-202	Gems Sensors	LS-700 Series Buna N 39049	Type 1 Mounting Stem		Group 1 Wiring
"	0	LSL	CD	107-2	Evaporation Pond(s) Combined Sump Low	Level Float	IN-202	Gems Sensors	LS-700 Series Buna N 39049	Type 1 Mounting Stem		Group 1 Wiring
45	0	LCP	CD	943	Evaporation Pond(s) Combined Sump Instrinsic Safety Control Panel	Enclosure	IN-202	Hoffman	A-161206LP	Type 12 Wall Mount		Provide devices as shown
"	0	LCP	CD	943	Evaporation Pond(s) Combined Sump Instrinsic Safety Control Panel	4-Channel Internal Intrinsic Safety Barrier	IN-202	Ronan	X57	4-channel assembly with dion Rail Mounting		24VDC Power
46	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Uninterruptible Power Supply	IN-204	Best	Fortress 1.15 kVA	FE1.15KDDBABCA		120V/120V with 30 minutes full load backup
47	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Surge Protection	IN-204	Sola	Sola Surge STV25K	Din Rail Mount		120V/120V surge protection
48	0	OWS	CD	961/962/963	Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Operator Interface Unit	IN-203	Rockwell	Panel View 600	Ethernet OIU		Runtime and Development software
49	0	PLC	CD	961/962/963	Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	SLC, I/O, Power Supply and Chassis	IN-204	Allen Bradley	SLC 500 Family	Ethernet Processor		See Control Block Drawing
50	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	SLC Programming and Communication Software	IN-204	Rockwell Software	RSLOGIX500	RSLINX LITE		
51	0			961/962/963	Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Ethernet Switch and Accessories	IN-204	Black Box	LE1401A, LE1419C, LE1425C	10/100 BASE T Fiber to Copper		RJ 45 cables and SC connectors
52	0	CP	CD	950	Landfill Crest Pad Building Control Panel	Enclosure	IN-204	Hoffman	A-724818FSD	Free Standing Nema 12 with double doors		Provide safety lockouts
53	0	CP	CD	951	Evaporation Ponds(s) Crest Pad Building Control Panel	Enclosure	IN-204	Hoffman	A-724818FSD	Free Standing Nema 12 with double doors		Provide safety lockouts
54	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	24 V dc Power Supplies	IN-204	IDEC	Model PS5RE24	100 Watts		
55	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Cooling Fan	IN-204	Hoffman	A-PA6AXFN			Size accordingly
56	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Temperature Thermostat	IN-204	Hoffman	A-TEMNO			
57	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Main and Sub Breakers	IN-204	Allen Bradley	Bulletin 1492-CB	20AMP		Size accordingly
58	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	High Density Breakers	IN-204	Allen Bradley	Bulletin 1492-GH			Size accordingly
59	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Programming Receptacle	IN-204	Hubbell	NEMA 5R-15	15 AMP		
60	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Incandescent Lighting	IN-204	Hoffman	ALTDB1	60 WATT T-10		
61	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Wiring Duct	IN-204	Hoffman	A-250250WH	Provide Cover		Size accordingly
62	0				Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Wiring Duct	IN-204	Hoffman	A-300300WH	Provide Cover		Size accordingly
63	0	-	-	-	Spare	Spare						
64	0			961/962/963	Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Fiber Patch Panel	IN-203	Provided under other contract				
65	0	CP	CD	952	SSSTF(s) Crest Pad Building Control Panel	Enclosure	IN-204	Hoffman	A-724818FSD	Free Standing Nema 12 with double doors		Provide safety lockouts
66	0	FT	CD	201	Evaporation West Pond Leak Detection and Recovery System	Flow Propeller Transmitter	IN-202	Provided by leachate collection pump vendor				

INSTRUMENT LIST

Item	Rev	Tag 1	Tag2	Tag3	Description	Description	P&ID	Manufacturer	Model Number	Additional Information	Options	Comments
		ISA	Process	Loop								
67	0	FI	CD	201	Evaporation West Pond Leak Detection and Recovery System	Flow Indicator	IN-202	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
68	0	FT	CD	202	Evaporation East Pond Leak Detection and Recovery System	Flow Propeller Transmitter	IN-202	Provided by leachate collection pump vendor				
69	0	FI	CD	202	Evaporation East Pond Leak Detection and Recovery System	Flow Indicator	IN-202	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
70	0	FT	CD	210	Raw Water	Flow Propeller Transmitter	IN-202	Provided by leachate collection pump vendor				
71	0	FI	CD	210	Raw Water	Flow Indicator	IN-202	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
72	0			961/962/963	Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s)	Switch Receptacle	IN-204	Hubbell	NEMA 5R-15	15 AMP		
73	0	FT	CD	211	Evaporator Pond Truck Loading	Flow Propeller Transmitter	IN-202	Provided by leachate collection pump vendor				
74	0	FI	CD	211	Evaporator Pond Truck Loading	Flow Indicator	IN-202	Action Instruments	Model V508	7-segment, 3-1/2 digit panel mounted LED signal indicator		120Vac power
75	0	LSH	CD	109	SSSTF Line Leak Detection	Level Float	IN-202	Gems Sensors	LS-700 Series Buna N 39049	Type 1 Mounting Stem		Group 1 Wiring
76	0			961/962/963	Landfill, SSSTF, and Evaporation Ponds(s) Crest Pad Building Control Panel(s) OUI Programming Software	Operator Interface Unit Programming Software	IN-203	Rockwell	PanelBuilder32	Runtime and Development software for the Programming of the OUI(s)		Runtime and Development software

PLC Input and Output List												
Item	Rev	Tag 1	Tag2	Tag3	Description	P&ID	Engineering	Range	Voltage/Current	Address	Typical Wiring	Notes
		ISA	Process	Loop			Units				Diagram	
1	0	FT	CD	203-1	Landfill Leachate Collection and Recovery System High Flow Pump Flow	IN-201	GPM	0-149	4-20mA	I:01/00	No. 1	
2	0	FT	CD	203-2	Landfill Leachate Collection and Recovery System Low Flow Pump Flow	IN-201	GPM	0-38	4-20mA	I:01/01	No. 1	
3	0	FT	CD	204	Landfill Leak Detection and Recovery System Pump Flow	IN-201	GPM	0-38	4-20mA	I:01/02	No. 1	
4	0	FT	CD	208	Landfill Secondary Leak Detection and Recovery System Pump Flow	IN-201	GPM	0-38	4-20mA	I:01/03	No. 1	
5	0	LT	CD	103	Landfill Leachate Collection and Recovery System Level	IN-201	Inches	0-12	4-20mA	I:01/04	No. 2	
6	0	LT	CD	104	Landfill Leak Detection and Recovery System Level	IN-201	Inches	0-12	4-20mA	I:01/05	No. 2	
7	0	LT	CD	108	Landfill Secondary Leak Detection and Recovery System Level	IN-201	Inches	0-12	4-20mA	I:01/06	No. 2	
8	0	TT	CD	1799	Landfill Crest Pad Building Temperature	IN-201	Celsius	-40 to 40	4-20mA	I:01/07	No. 3	
9	0				Blank Module							Blank in Address Slot 2
10	0	HS	CD	203-1	Landfill Leachate Collection and Recovery System High Flow Pump Auto Status	IN-201	Auto/Manual		24V dc	I:03/00	No. 4	
11	0	YL	CD	203-1	Landfill Leachate Collection and Recovery System High Flow Pump On Status	IN-201	On/Off		24V dc	I:03/01	No. 4	
12	0	HS	CD	203-2	Landfill Leachate Collection and Recovery System Low Flow Pump Auto Status	IN-201	Auto/Manual		24V dc	I:03/02	No. 4	
13	0	YL	CD	203-2	Landfill Leachate Collection and Recovery System Low Flow Pump On Status	IN-201	On/Off		24V dc	I:03/03	No. 4	
14	0	HS	CD	204	Landfill Leachate Collection and Recovery System Pump Auto Status	IN-201	Auto/Manual		24V dc	I:03/04	No. 4	
15	0	YL	CD	204	Landfill Leachate Collection and Recovery System Pump On Status	IN-201	On/Off		24V dc	I:03/05	No. 4	
16	0	HS	CD	208	Landfill Secondary Leachate Collection and Recovery System Pump Auto Status	IN-201	Auto/Manual		24V dc	I:03/06	No. 4	
17	0	YL	CD	208	Landfill Secondary Leachate Collection and Recovery System Pump On Status	IN-201	On/Off		24V dc	I:03/07	No. 4	
18	0	LSH	CD	105	Landfill Crest Pad Building Sump Level High	IN-201	High/Normal		24V dc	I:03/08	No. 4	
19	0	LSHH	CD	105	Landfill Crest Pad Building Sump Level High High	IN-201	High-High /Normal		24V dc	I:03/09	No. 4	High High Shuts Down Process Pumps
20	0	LSL	CD	105	Landfill Crest Pad Building Sump Level Low	IN-201	Low/Normal		24V dc	I:03/10	No. 4	
21	0	JSH	CD	1799	Landfill Crest Pad Building Power Status	IN-201	Normal/Fail		24V dc	I:03/11	No. 4	
22	0	NE	CD	1799	Landfill Crest Pad Building Smoke Alarm	IN-201	Normal/Fail		24V dc	I:03/12	No. 4	
23	0	ZS	CD	1799	Landfill Crest Pad Building Door Position Status	IN-201	Open/Close		24V dc	I:03/13	No. 4	
24	0	HS	CD	205	Landfill Crest Pad Building Sump Pump Auto Status	IN-201	Auto/Manual		24V dc	I:03/14	No. 4	
25	0	YL	CD	205	Landfill Crest Pad Building Sump Pump On Status	IN-201	On/Off		24V dc	I:03/15	No. 4	Wire in spare inputs
26	0				Blank Module							Blank in Address Slot 4
27	0	YS	CD	203-1	Landfill Leachate Collection and Recovery System High Flow Pump Start Command	IN-201	Start/Stop		24V dc	O:05/00	No. 4	
28	0	YS	CD	203-2	Landfill Leachate Collection and Recovery System Low Flow Pump Start Command	IN-201	Start/Stop		24V dc	O:05/01	No. 4	
29	0	YS	CD	204	Landfill Leak Detection and Recovery System Pump Start Command	IN-201	Start/Stop		24V dc	O:05/02	No. 4	
30	0	YS	CD	208	Landfill Secondary Leak Detection and Recovery System Pump Start Command	IN-201	Start/Stop		24V dc	O:05/03	No. 4	
31	0	YS	CD	1799	Landfill Crest Pad Building General Alarm	IN-201	Normal/Fail		24V dc	O:05/04	No. 5	
32	0				Spare Output	IN-201			24V dc	O:05/05	No. 4	Wire in spare outputs
33	0				Spare Output	IN-201			24V dc	O:05/06	No. 4	Wire in spare outputs
34	0				Spare Output	IN-201			24V dc	O:05/07	No. 4	Wire in spare outputs
35	0				Blank Module							Blank in Address Slot 6
36	0	FT	CD	207	Evaporation Pond Combined Sump Flow	IN-202	GPM	0-38	4-20mA	I:01/00	No. 1	
37	0	FT	CD	327	Evaporation Pond Truck Loading/Unloading Flow	IN-202	GPM	0-149	4-20mA	I:01/01	No. 1	
38	0	FT	CD	330	Evaporation Pond Wastewater from SSSTF Flow	IN-202	GPM	0-149	4-20mA	I:01/02	No. 1	
39	0	LT	CD	101	Evaporation West Pond Leak Detection and Recovery System Level	IN-202	Inches	0-12	4-20mA	I:01/03	No. 2	
40	0	LT	CD	102	Evaporation East Pond Leak Detection and Recovery System Level	IN-202	Inches	0-12	4-20mA	I:01/04	No. 2	
41	0	TT	CD	1798	Evaporation Pond(s) Crest Pad Building Temperature	IN-202	Celsius	-40 to 40	4-20mA	I:01/05	No. 3	
42	0	FT	CD	201	West Evaporation Pond Leak Detection Flow	IN-202	GPM	0-38	4-20mA	I:01/06	No. 1	
43	0	FT	CD	202	East Evaporation Pond Leak Detection Flow	IN-202	GPM	0-38	4-20mA	I:01/07	No. 1	

PLC Input and Output List

Item	Rev	Tag 1	Tag2	Tag3	Description	P&ID	Engineering	Range	Voltage/Current	Address	Typical Wiring	Notes
		ISA	Process	Loop			Units				Diagram	
44	0	FT	CD	210	Raw Water Flow	IN-202	GPM	0-149	4-20mA	I:02/00	No. 1	
45	0	FT	CD	211	Evaporator Pad Truck Loading Flow Detection	IN-202	GPM	0-38	4-20mA	I:02/01	No. 1	
46	0				Spare Input	IN-202			4-20mA	I:02/02		Wire in spare inputs
47	0				Spare Input	IN-202			4-20mA	I:02/03		Wire in spare inputs
48	0				Spare Input	IN-202			4-20mA	I:02/04		Wire in spare inputs
49	0				Spare Input	IN-202			4-20mA	I:02/05		Wire in spare inputs
50	0				Spare Input	IN-202			4-20mA	I:02/06		Wire in spare inputs
51	0				Spare Input	IN-202			4-20mA	I:02/07		Wire in spare inputs
52	0	HS	CD	201	Evaporation Pond(s) Leak Detection and Recovery System Pump Auto Status	IN-202	Auto/Manual		24V dc	I:03/00	No. 4	
53	0	YL	CD	201	Evaporation Pond(s) Leak Detection and Recovery System Pump On Status	IN-202	On/Off		24V dc	I:03/01	No. 4	
54	0	HS	CD	207	Evaporation Pond(s) Combined Sump Pump Auto Status	IN-202	Auto/Manual		24V dc	I:03/02	No. 4	
55	0	YL	CD	207	Evaporation Pond(s) Combined Sump Pump On Status	IN-202	On/Off		24V dc	I:03/03	No. 4	
56	0	LSH	CD	106	Evaporation Pond(s) Crest Pad Building Sump Level High	IN-202	High/Normal		24V dc	I:03/04	No. 4	
57	0	LSHH	CD	106	Evaporation Pond(s) Crest Pad Building Sump Level High High	IN-202	High-High/Normal		24V dc	I:03/05	No. 4	High High Shuts Down Process Pumps
58	0	JSH	CD	1798	Evaporation Pond(s) Crest Pad Building Power Status	IN-202	Normal/Fail		24V dc	I:03/06	No. 4	
59	0	NE	CD	1798	Evaporation Pond(s) Crest Pad Building Smoke Detector	IN-202	Normal/Fail		24V dc	I:03/07	No. 4	
60	0	ZS	CD	1798	Evaporation Pond(s) Crest Pad Building Door Postion Status	IN-202	Open/Close		24V dc	I:03/08	No. 4	
61	0	LSH	CD	499	Landfill Leachate Transmission Line Leak Detection Switch	IN-202	High /Normal		24V dc	I:03/09	No. 4	
62	0	LSH	CD	107	Evaporation Pond(s) Combined Sump Level High	IN-202	High /Normal		24V dc	I:03/10	No. 4	
63	0	LSHH	CD	107	Evaporation Pond(s) Combined Sump Level High High	IN-202	High High /Normal		24V dc	I:03/11	No. 4	
64	0	LSL	CD	107-1	Evaporation Pond(s) Combined Sump Level Low	IN-202	Low/Normal		24V dc	I:03/12	No. 4	
65	0	HS	CD	201	Evaporation Pond(s) Leak Detection and Recovery System Pump Auto Status	IN-202	Auto/Manual		24V dc	I:03/13	No. 4	
66	0	YL	CD	201	Evaporation Pond(s) Leak Detection and Recovery System Pump On Status	IN-202	On/Off		24V dc	I:03/14	No. 4	
67	0	HS	CD	202	Evaporation Pond(s) Leak Detection and Recovery System Pump Auto Status	IN-202	Auto/Manual		24V dc	I:03/15	No. 4	
68	0	YL	CD	202	Evaporation Pond(s) Leak Detection and Recovery System Pump On Status	IN-202	On/Off		24V dc	I:04/00	No. 4	
69	0	LSH	CD	109	SSSTF Line Leak Detection Switch	IN-202	High /Normal		24V dc	I:04/01	No. 4	
70	0				Spare Input	IN-202			24V dc	I:04/02		Wire in spare inputs
71	0				Spare Input	IN-202			24V dc	I:04/03		Wire in spare inputs
72	0				Spare Input	IN-202			24V dc	I:04/04		Wire in spare inputs
73	0				Spare Input	IN-202			24V dc	I:04/05		Wire in spare inputs
74	0				Spare Input	IN-202			24V dc	I:04/06		Wire in spare inputs
75	0				Spare Input	IN-202			24V dc	I:04/07		Wire in spare inputs
76	0				Spare Input	IN-202			24V dc	I:04/08		Wire in spare inputs
77	0				Spare Input	IN-202			24V dc	I:04/09		Wire in spare inputs
78	0				Spare Input	IN-202			24V dc	I:04/10		Wire in spare inputs
79	0				Spare Input	IN-202			24V dc	I:04/11		Wire in spare inputs
80	0				Spare Input	IN-202			24V dc	I:04/12		Wire in spare inputs
81	0				Spare Input	IN-202			24V dc	I:04/13		Wire in spare inputs
82	0				Spare Input	IN-202			24V dc	I:04/14		Wire in spare inputs
83	0				Spare Input	IN-202			24V dc	I:04/15		Wire in spare inputs
84	0	YS	CD	201	Evaporation Pond(s) Leak Detection and Recovery System Pump Start Command	IN-202	Start/Stop		24V dc	O:05/00	No. 4	
85	0	YS	CD	207	Evaporation Pond(s) Combined Sump Pump Start Command	IN-202	Start/Stop		24V dc	O:05/01	No. 4	
86	0	YS	CD	1798	Evaporation Pond(s) Crest Pad Building General Alarm	IN-202	Normal/Fail		24V dc	O:05/02	No. 5	

PLC Input and Output List												
Item	Rev	Tag 1	Tag2	Tag3	Description	P&ID	Engineering	Range	Voltage/Current	Address	Typical Wiring	Notes
		ISA	Process	Loop			Units				Diagram	
87	0	YS	CD	202	Evaporation Pond(s) Leak Detection and Recovery System Pump Start Command	IN-202	Start/Stop		24V dc	O:05/03	No. 4	
88	0				Spare Output	IN-202			24V dc	O:05/04	No. 4	Wire in spare outputs
89	0				Spare Output	IN-202			24V dc	O:05/05	No. 4	Wire in spare outputs
90	0				Spare Output	IN-202			24V dc	O:05/06	No. 4	Wire in spare outputs
91	0				Spare Output	IN-202			24V dc	O:05/07	No. 4	Wire in spare outputs
92	0				Blank Module							Blank in Address Slot 6

CH2M HILL

INSTRUMENT CALIBRATION SHEET

Rev.06.05.92

COMPONENT	MANUFACTURER	PROJECT
Code:	Name:	Number:
Name:	Model:	Name:
	Serial #:	

FUNCTIONS

	RANGE	VALUE	UNITS
Indicate? Y / N	Chart:		
Record? Y / N	Scale:		
Transmit/ Convert? Y / N	Input:		
	Output:		

COMPUTING FUNCTIONS? Y / N
Describe:

CONTROL? Y / N
Action? direct / reverse
Modes? P / I / D

SWITCH? Y / N
Unit Range:
Differential: fixed/adjustable
Reset? automatic / manual

ANALOG CALIBRATIONS

REQUIRED			AS CALIBRATED			
Input	Indicated	Output	Increasing Input		Decreasing Input	
			Indicated	Output	Indicated	Output
CONTROL MODE SETTINGS:			P:	I:	D:	

DISCRETE CALIBRATIONS

	REQUIRED		AS CALIBRATED		Note No.
Number	Trip Point (note rising or falling)	Reset Pt.	Trip Point (note rising or falling)	Reset Pt.	
1.					
2.					
3.					
4.					
5.					
6.					
7.					

#	NOTES:

Component Calibrated and Ready for Startup
By:
Date:
Tag No.:

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INSTRUMENT CALIBRATION SHEET

EXAMPLE - ANALYZER/TRANSMITTER

Rev.06.05.92

COMPONENT	MANUFACTURER	PROJECT
Code: *A7*	Name: *Leeds & Northrup*	Number: *WDC30715.B2*
Name: *pH Element & Analyzer/Transmitter*	Model: *12429-3-2-1-7*	Name: *UOSA AWT PHASE 3*
	Serial #: *11553322*	

FUNCTIONS

	RANGE	VALUE	UNITS	COMPUTING FUNCTIONS? N	CONTROL? N
Indicate? Y Record? N	Chart:			Describe:	Action? direct / reverse Modes? P / I / D
	Scale:	*1-14*	*pH units*		SWITCH? N Unit Range:
Transmit/ Convert? Y	Input:	*1-14*	*pH units*		Differential: fixed/adjustable
	Output:	*4-20*	*mA dc*		Reset? automatic / manual

ANALOG CALIBRATIONS

REQUIRED			AS CALIBRATED			
			Increasing Input		Decreasing Input	
Input	Indicated	Output	Indicated	Output	Indicated	Output
1.0	*1.0*	*4.0*	*1.0*	*4.0*	*1.0*	*3.9*
2.3	*2.3*	*5.6*	*2.2*	*5.5*	*2.3*	*5.6*
7.5	*7.5*	*12.0*	*7.5*	*11.9*	*7.5*	*12.0*
12.7	*12.7*	*18.4*	*12.7*	*18.3*	*12.6*	*18.3*
14.0	*14.0*	*20.0*	*14.0*	*20.0*	*14.0*	*20.0*
CONTROL MODE SETTINGS:			P: *N.A.*	I:	D:	

DISCRETE CALIBRATIONS

	REQUIRED			AS CALIBRATED	
	Number	Trip Point (note rising or falling)	Reset Pt.	Trip Point (note rising or falling)	Reset Pt.
1.		*N.A.*		*N.A.*	
2.					
3.					
4.					
5.					
6.					
7.					

Note No
1.

#	NOTES:
	1. Need to recheck low pH calibration solutions.

Component Calibrated and Ready for Startup

By: *J.D. Sewell*

Date: *Jun-6-92*

Tag No.: AIT-12-6[pH]

CH2M HILL **I&C VALVE ADJUSTMENT SHEET** Rev.06.05.92

PARTS	Project Name:	Project Number:
Body	Type:	Mfr:
	Size:	Model:
	Line Connection:	Serial #:
Operator	Type:	Mfr:
	Action:	Model:
	Travel:	Serial #:
Positioner	Input Signal:	Mfr:
	Action:	Model:
	Cam:	Serial #:
Pilot Solenoid	Action:	Mfr:
	Rating:	Model:
		Serial #:
I/P Converter	Input:	Mfr:
	Output:	Model:
	Action:	Serial #:
Position Switch	Settings:	Mfr:
	Contacts:	Model:
		Serial #:
Power Supply	Type:	Air Set Mfr:
	Potential:	Model:
		Serial #:

ADJUSTMENTS	Initial	Date	**VERIFICATION**	Initial	Date
Air Set			Valve Action		
Positioner			Installation		
Position Switches			Wire Connection		
I/P Converter			Tube Connection		
Actual Speed					

REMARKS:	**Valve Ready for Startup**
	By:
	Date:
	Tag No.:

CH2M HILL **I&C VALVE ADJUSTMENT SHEET** Rev.06.05.92

EXAMPLE

PARTS	Project Name: *SFO SEWPCP*	Project Number: *SFO10145.G2*
Body	Type: *Vee-Ball*	Mfr: *Fisher Controls*
	Size: *4-inch*	Model: *1049763-2*
	Line Connection: *159 # ANSI Flanges*	Serial #: *1003220*
Operator	Type: *Pneumatic Diaphragm*	Mfr: *Fisher Controls*
	Action: *Linear - Modulated*	Model: *4060D*
	Travel: *3-inch*	Serial #: *2007330*
Positioner	Input Signal: *3-15 psi*	Mfr: *Fisher Controls*
	Action: *Direct - air to open*	Model: *20472T*
	Cam: *Equal percentage*	Serial #: *102010*
Pilot Solenoid	Action:	Mfr:
	Rating: *None*	Model:
		Serial #:
I/P Converter	Input: *4-20 mA dc*	Mfr: *Taylor*
	Output: *3-15 psi*	Model: *10-T-576-3*
	Action: *Direct*	Serial #: *1057-330*
Position Switch	Settings: *Closed / Open 5 deg, rising*	Mfr: *National Switch*
	Contacts: *Close / Close*	Model: *1049-67-3*
		Serial #: *156 &157*
Power Supply	Type: *Pneumatic*	Air Set Mfr: *Air Products*
	Potential: *40 psi*	Model: *3210D*
		Serial #: *1107063*

ADJUSTMENTS	Initial	Date	**VERIFICATION**	Initial	Date
Air Set	*JDS*	*Jun-06-92*	Valve Action	*JDS*	*Jun-03-92*
Positioner	*JDS*	*Jun-06-92*	Installation	*JDS*	*Jun-03-92*
Position Switches	*JDS*	*Jun-06-92*	Wire Connection	*JDS*	*Jun-04-92*
I/P Converter	*JDS*	*Jun-07-92*	Tube Connection	*JDS*	*Jun-04-92*
Actual Speed	*JDS*	*Jun-07-92*			

REMARKS: *Valve was initially installed backwards.*	**Valve Ready for Startup**
Observed to be correctly installed May-25-92	By: *J.D. Sewell*
	Date: *Jun-07-92*
	Tag No.: *FCV-10-2-1*

CH2M HILL **PERFORMANCE ACCEPTANCE TEST SHEET** *Rev.06.05.92*

Project Name:	Project No.:

Demonstration Test(s): For each functional requirement of the loop:
(a) List and number the requirement. (b) Briefly describe the demonstration test.
(c) Cite the results that will verify the required performance. (d) Provide space for signoff.

Forms/Sheets Verified	By	Date	**Loop Accepted by Contractor**
Loop Status Report			By:
Instrument Calibration Sheet			Date:
I&C Valve Calibration Sheet			
Performance Acceptance Test	By	Date	
Performed			
Witnessed			Loop No.:

CH2M HILL **PERFORMANCE ACCEPTANCE TEST SHEET** *Rev.06.05.92*

EXAMPLE

Project Name: *SFO SEWPCP Plant Expansion*	Project No.: *SFO12345.C1*

Demonstration Test(s): For each functional requirement of the loop:
(a) List and number the requirement. (b) Briefly describe the demonstration test.
(c) Cite the results that will verify the required performance. (d) Provide space for signoff.

1. MEASURE EFFLUENT FLOW

1.a With no flow, water level over weir should be zero and

FIT indicator should read zero. Jun-20-92 BDG

2. FLOW INDICATION AND TRANSMISSION TO LP & CCS

With flow, water level and FIT indicator should be related by expression

*Q(MGD) = 429*H**(2/3) (H = height in inches of water over weir).*

Vary H and observe that following.

2.a Reading of FIT indicator. Jun-6-92 BDG

2.b Reading is transmitted to FI on LP-521-1. Jun-6-92 BDG

2.c Reading is transmitted and displayed to CCS. Jun-6-92 BDG

H(measured)	*0*	*5*	*10*	*15*
Q(computed)	*0*	*47.96*	*135.7*	*251.7*
Q(FIT indicator)	*0*	*48.1*	*137*	*253*
Q(LI on LP-521-1)	*0*	*48.2*	*138*	*254*
Q(display by CCS)	*0*	*48.1*	*136.2*	*252.4*

Forms/Sheets Verified	By	Date	**Loop Accepted by Contractor**
Loop Status Report	*J.D. Sewell*	*May-18-92*	By: *J.D. Smith*
Instrument Calibration Sheet	*J.D. Sewell*	*May-18-92*	Date: *Jun-6-92*
I&C Valve Calibration Sheet	*N.A.*		
Performance Acceptance Test	By	Date	
Performed	*J. Blow MPSDC Co.*	*Jun-6-92*	
Witnessed	*B.deGlanville*	*Jun-6-92*	Loop No.: *30-12*

SECTION 15021--HIGH DENSITY POLYETHYLENE (HDPE) PIPE

PART 1--GENERAL

REFERENCES:

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D792	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
ASTM D1248	Specification for Polyethylene Plastics Molding and Extrusion Materials.
ASTM D1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique.
ASTM D2513	Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
ASTM D2657	Practice for Heat Joining of Polyolefin Pipe and Fittings.
ASTM D2683	Specification for Socket-Type Polyethylene Fittings for Outside-Diameter Controlled Polyethylene Pipe and Tubing.
ASTM D3083	Standard Specification for Flexible Poly (Vinyl Chloride) Plastic Sheeting for Pond, Canal, and Reservoir Lining.
ASTM D3350	Specification for Polyethylene Plastics Pipe and Fitting Materials.
ASTM F714	Standard Specification for Polyethylene Plastic Pipe (SDR-PR) Based on Outside Diameter.

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 192.285	Plastic pipe; qualifying persons to make joints.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ASME B31.3 Fluid Category D ASME Code for Pressure Piping

SUBMITTALS:

Manufacturer's Certificate of Conformance for piping materials and fittings.

Bonding Procedure Specifications and Qualifications: Submit fusion procedures for bonding of pipe and fittings. Procedures shall include qualification records and comply with the ASME B31.3 Chapter VII.

Bonder Performance Qualification Records: Submit qualification records for all personnel performing fusion of pipe and fitting. Qualifications shall comply with ASME B31.3 Chapter VII.

See the Vendor Data Schedule for any additional submittal requirements.

DESCRIPTION:

Pipe: This section includes all high density polyethylene (HDPE) pipe used in the ICDF landfill including but not limited to:

Leachate collection piping on floor and cleanout access pipes on the slopes of the trench.

PART 2--PRODUCTS

HDPE MATERIALS:

All HDPE pipe shall meet the following requirements:

Specific Gravity: As determined by ASTM D792 or D1505, 0.94 minimum.

Resistance to Soil Burial: As determined by ASTM D3083, as modified by NSF Standard 54 Appendix A, Part 3. At least 90 percent strength retained.

Melt Index: As determined by ASTM D1238 Condition 190.2.16, 0.1 to 1.1 g per 10 min.

HDPE PIPE:

Resin: HDPE pipe shall be manufactured from first quality polyethylene resin containing no more than 2 percent clean recycled polymer by weight The cell classification shall be 345434C minimum per ASTM D3350. Pipe shall be rated PE3408. Pipe and fittings shall be in compliance with schedule attached as supplement (see Attachment 1, HIGH DENSITY POLYETHYLENE (HDPE) PIPE) or as shown on the Drawings.

Quality: The pipe shall have uniform wall thickness and shall be uniform in color, opacity, density, and other physical properties. Pipe shall be homogeneous throughout and free of visible cracks, holes, blisters, bubbles, undispersed raw materials, or any contamination by

foreign matter. Any pipe with nicks, scrapes, or gouges deeper than 10 percent of the nominal wall thickness shall be rejected.

Form: Pipe may be supplied in a continuous extruded seamless piece or in sections.

Manufacturer's Certificate of Conformance: The Manufacturer shall submit a Certificate of Conformance for the HDPE pipe supplied for the ICDF project, which will include the pipe grade PE-3408, and identify the Cell Classification per ASTM D3350.

All HDPE pipe shall be SDR 17 unless indicated otherwise on the Drawings.

Fittings: Fittings shall conform to the requirements of Articles HDPE MATERIALS and HDPE PIPE of this section and shall be compatible with the other components of the piping system.

SLOTTED PIPE:

Leachate Collection Piping: Leachate collection and leak detection piping on the floor of the landfill and elsewhere as shown on the Drawings shall be slotted. Cleanout access pipes and leachate transmission piping shall not be slotted.

In addition to meeting all other requirements of this section, slotted pipe shall have slots 0.2 inch wide and 2 inches long, in four places equidistant around the pipe. Slots shall provide a minimum of 8 square inches of open area per linear foot of pipe. Slotted pipes shall be free of cutting debris from the slot cutting process.

PART 3--EXECUTION

GENERAL:

All HDPE pipe and fittings shall be installed in conformance with ASME B31.3 Fluid Category D.

DIMENSIONS:

Piping dimensions shown on the Drawings are approximate. It is the Construction Subcontractor's responsibility to furnish and install piping of the proper dimensions, which will properly fit with the connecting elements, pipes, fittings, pumps, etc.

INSTALLATION:

Pipe shall be handled and stored in such a manner as to ensure a sound, undamaged condition.

Pipe shall be cut in a neat, workmanlike manner using an approved mechanical cutter that will not damage the pipe.

Joining of HDPE pipe to HDPE pipe shall be accomplished by thermal butt fusion joint; no solvent welding, adhesive welding, or electrofusion couplings shall be allowed. Slotted leachate collection piping shall be joined with thermal butt fusion joints. Pipe shall be joined per ASTM D2657 and manufacturer's recommendations. Installation personnel who join HDPE pipe shall be experienced and certified in accordance with ASME B31.3.

Single butt fusion welds shall be used to create pipe sections as long as practicable or as specified in the Construction Subcontractor's procedure. Fabricated pipe sections and fittings may be joined by the double butt fusion process.

During installation, the pipe shall not be pulled across sharp projections that could cause gouges, kinks, or other types of damage. To minimize "snaking" due to thermal expansion, protect pipe from direct sunlight, or limit unrestrained length of pipe during installation.

Placement of Buried Pipes:

Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange or connection.

The pipe shall not be dropped into the trench. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe. The full length of the pipe shall be firmly bedded on the trench bottom.

The pipe shall be bedded in such a way as to maintain grade with a tolerance of -0.0 percent, +0.5 percent.

Pipe Base and Pipe Zone: As specified in Section 02320, TRENCH BACKFILL.

Keep trench dry until pipe laying and joining are completed.

Prevent foreign material from entering pipe during placement.

Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.

Install closure sections and adapters for gravity piping at locations where pipe laying changes direction.

After joint has been made, check pipe alignment and grade.

Place sufficient pipe zone material to secure pipe from movement before next joint is installed.

Prevent uplift and floating of pipe prior to backfilling.

Place pipe along pipe runs starting at one end and moving towards the other to avoid joints that will not be feasible with butt fusion.

Tolerances:

Horizontal position of pipe centerline on alignment around curves maximum variation of 1.75 feet from position shown.

Pipe Cover: Minimum 5 feet, unless otherwise shown.

Temporarily close pipe ends as required to avoid introducing dirt or other foreign material into the pipe.

Trenching and backfilling operations shall be conducted in accordance with the requirements of Section 02320, TRENCH BACKFILL for utility trenching. If trenching is used, underlying materials shall not be disturbed or damaged in anyway. Backfilling operations shall ensure that no voids are present under or at the sides of the pipe. Backfill shall initially be placed to the top of the pipe, then hand compacted. The remainder of the trench shall then be backfilled and compacted by hand or with a power tamper only.

On the floor of the landfill, pipe may be placed directly on geosynthetic layers prior to placing drainage gravel. Placement of gravel around pipes shall be by hand unless otherwise approved by the BBWI Construction Manager. Placement operations shall ensure that no voids are present under or at the sides of the pipe. Placement operations shall not disturb the position of the pipe.

Where flanged joints are used, the bolts shall be evenly torqued using a crossing pattern to gradually tighten the lug nuts. Torque values shall be as recommended by the flange manufacturer. Flanged joints shall be retorqued after one hour or more has passed. Apply anti-sieze compound on all stainless steel bolts before tightening.

Flaws (minor imperfections, damaged areas, etc.) in HDPE pipe with a depth of 10 percent or less of the nominal wall thickness will not require repair or replacement. In double containment systems, carrier pipe with flaws deeper than 10 percent of the wall thickness shall be replaced. Single pipe or containment pipe with flaws between 10 and 25 percent of the wall thickness shall be repaired in accordance with the pipe manufacturer's recommendations. The Construction Subcontractor shall certify in writing that the repaired area will have material properties that meet or exceed those of intact pipe. Any pipe with flaws deeper than 25 percent of the nominal wall thickness shall be rejected.

Butt-fusion shall be performed in accordance with pipe manufacturer's recommendations as to equipment and technique.

Slotted Pipe: Remove internal weld beads from the horizontal sections of slotted pipe where the LCRS and LDRS pumps will be placed.

FIELD QUALITY CONTROL

Contractor Supplied Testing

Examination:

Perform examination of fusion joints in accordance with the requirements as stated in ASME B31.3, Chapter VII, for Category D Fluid Service and as otherwise applicable.

Heat fusion bonds shall meet the applicable acceptance criteria in Table A341.3.2, Acceptance Criteria for Bonds, including criteria for unfilled and unbonded areas in joints and protrusion of material into pipe bore.

Acceptance Testing:

No system tests are required.

General:

Surveillance will be performed by the Contractor's Representative to verify compliance of work to the drawings and specifications.

END OF SECTION 15021

ATTACHMENT 1
HIGH DENSITY POLYETHYLENE (HDPE) PIPE

Item	Size	Description
General	All	Pipe lengths, fittings, and flanged connections to be joined by thermal butt-fusion shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.
Pipe		Pipe shall be SDR* 17 unless otherwise noted. Protection shall be provided against ultraviolet light degradation using carbon black, not less than 2 percent well dispersed in the resin. Pipe wall thickness shall reflect the required SDR* and diameter, as shown in Table 8, ASTM F714. Pressure rating shall be 100 psi minimum. *SDR: standard dimension ratio = OD/thickness
Fittings	6-inch and smaller	Molded fittings, butt fusion joined, conforming to ASTM D3261.
	8-inch and larger	Same as pipe, butt fusion joined, conforming to ASTM D3350. All fittings shall have same pressure rating as pipe, unless otherwise noted.
Flanges		ASTM A351 Type 316/CF8M stainless steel, 150 pound, ANSI B16.5 convoluted back-up ring with one-piece molded polyethylene stub ends, same rating as pipe.
Bolting		Stainless steel, ASTM A193/A193M Grade B8 studs and Galling Resistant Nitronic 60 nuts, ASTM A194 Grade 8S (UNS S21800). Washers shall be same material as bolts.
Gaskets		Flat ring, 1/8-inch ethylene propylene rubber (EPR).

SECTION 15022--HIGH DENSITY POLYETHYLENE MANHOLES

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D1248	Specification for Polyethylene Plastics Molding and Extrusion Materials.
ASTM D3350	Specification for Polyethylene Plastics Pipe and Fitting Materials.

PART 2--PRODUCTS

HDPE MANHOLES:

The manhole shall be manufactured by the fabrication of high-density polyethylene (HDPE pipe). The riser shall be made of HDPE plastic compound meeting the requirements of Type III, Class C, Category 5, Grade P34 as defined in ASTM D1248. The cell classification shall be 345444C per ASTM D3350. Pipe shall be rated PE3408.

Flatstock shall meet or exceed ASTM D1248 requirements for Type III, Class A, B or C, Category 3, Grade G5. Flatstock shall be manufactured from first quality polyethylene resin containing no more than 2 percent clean recycled polymer by weight.

HDPE pipe and flatstock used to fabricate the HDPE manhole shall meet all product requirements of Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE. HDPE pipe shall be minimum SDR 32.5. Manhole dimensions as shown.

Welding rods, connecting couplings, pipe collars and other materials, as required to complete the installation, shall be of the same plastic as the flatstock, and supplied by the same manufacturer.

Piping, valves and appurtenances shall meet the requirements of Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE, Section 15060, PIPING–GENERAL, and Section 15100, VALVES AND OPERATORS.

An access cover shall be provided for each manhole. Cover shall be 48-inch diameter HDPE lid (minimum 1-1/2 inches thick) bolted to 48-inch diameter flanged HDPE section. Bolts shall be stainless steel penta head. Attach aluminum or galvanized steel angle stiffeners on the underside to prevent lid from sagging.

PART 3--EXECUTION

FABRICATION:

Inlet and outlet piping shall be installed as shown on Drawings by fabricator prior to delivery to site.

The manhole shall be fabricated with the minimum number of welds practical.

All welds shall be heat fused in accordance with ASTM D2657 on equipment specifically designed for welding thermoplastic sheets or extrusion welded by precertified welders.

INSTALLATION:

Manholes shall be handled and stored according to manufacturer's recommendations and in such a manner as to ensure a sound undamaged condition.

Excavation and backfilling operations shall be conducted in accordance with Section 02316, EXCAVATION, and Section 02315, FILL AND BACKFILL.

Joining of HDPE to HDPE shall be done by thermal butt or socket fusion, no solvent or adhesive welding shall be allowed. HDPE welding shall be qualified and approved welders.

Install piping, valves and appurtenances, and pipe hangers and supports in accordance with Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE, Section 15060, PIPING-GENERAL, and Section 15100, VALVES AND OPERATORS.

Install frame and access cover in accordance with manufacturer's instructions.

END OF SECTION

SECTION 15060--PIPING-GENERAL

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B1.20.1	Pipe Threads, General Purpose (Inch).
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings.
ANSI B16.3	Malleable Iron Threaded Fittings.
ANSI B16.5	Pipe Flanges and Flanged Fittings.
ANSI B16.11	Forged Fittings, Socket-Welding and Threaded.
ANSI B16.21	Nonmetallic Flat Gaskets for Pipe Flanges.
ANSI B16.42	Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.3	Chemical Plant and Petroleum Refinery Piping.
ASME B36.10M	Welded and Seamless Wrought Steel Pipe.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
ASTM A536	Standard Specification for Ductile Iron Castings.
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts.
ASTM D1248	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
ASTM D1785	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
ASTM D2467	Standard Specification for Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

ASTM D2564	Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C153/ A21.53	Ductile-Iron Compact Fittings 3 Inches Through 24 Inches and 54 Inches Through 64 Inches, for Water Service.

DEPARTMENT OF ENERGY (DOE)

DOE-ID Architectural Engineering Standards:
1540, Piping – General Requirements.
Appendix M, Piping Materials, Pipe Numbering, Labeling and Color Coding.

SEQUENCING AND SCHEDULING:

Commence disinfection after completion of following: Hydrostatic and pneumatic testing, pressure testing, functional and performance testing and acceptance of pipelines, pumping systems, structures, and equipment.

PART 2--PRODUCTS

PIPING:

High Density Polyethylene Piping: As specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

FIRE PROTECTION PIPING:

As specified in Section 15505, UNDERGROUND FIRE PROTECTION PIPING.

RAW WATER PIPING:

As specified herein and in Section 15505, UNDERGROUND FIRE PROTECTION PIPING, as applicable.

Others as specified on Piping Data Sheet(s) and Piping Schedule located at the end of this section as Supplement.

Diameters Shown:

Standardized Products: Nominal size.

Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.

JOINTS:

Flanged Joints:

Flat-faced carbon steel or alloy flanges when mating with flat-faced cast or ductile iron flanges.

Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

Threaded Joints: NPT taper pipe threads in accordance with ANSI B1.20.1.

Thrust Tie-Rod Assemblies: NFPA 24; tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.

Mechanical Joint Anchor Gland Follower:

Ductile iron anchor type, wedge action, with breakoff tightening bolts.

Manufacturer and Product: EBAA Iron Inc.; Megalug.

Flexible Mechanical Compression Joint Coupling:

Stainless steel, ASTM A276, Type 305 bands.

Manufacturers:

Pipeline Products Corp.

Fernco Joint Sealer Co.

Mechanical connections of high density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through flanged connections consisting of the following:

A polyethylene stub end thermally butt-fused to end of pipe.

ASTM A240, Type 304 stainless steel backing flange, 125-pound, ANSI B16.1 standard. Insulating flanges shall be used where shown.

Bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to manufacturer's standard. Retorque nuts after 4 hours.

Gaskets as specified on Data Sheet.

GASKET LUBRICANT:

Lubricant shall be supplied by pipe manufacturer and no substitute or "or-equal" will be allowed.

DOUBLE WALL CONTAINMENT PIPING SYSTEM:

As specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

THRUST BLOCKS:

Concrete: As specified in Section 03301, CONCRETE.

VENT AND DRAIN VALVES:

Pipeline 2-Inch Diameter and Smaller: 1/2-inch vent, 1-inch drain, unless shown otherwise.

Pipelines 2-1/2-Inch Diameter and Larger: 3/4-inch vent, 1-inch drain, unless shown otherwise.

WATER HOSE:

Furnish six 50-foot length(s) of 1-1/2-inch., EPDM black cover and EPDM tube, reinforced with two textile braids. Furnish each length with brass male and female NST hose thread couplings to fit hose nozzle(s) and hose valve(s) specified.

Rated minimum working pressure of 200 psi.

Manufacturers:

Goodyear.

Boston.

FABRICATION:

Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer.

FINISHES:

Factory prepare, prime, and finish coat in accordance with Pipe Data Sheet(s) and Piping Schedule.

Galvanizing:

Hot-dip applied, meeting requirements of ASTM A153.

Electroplated zinc or cadmium plating is unacceptable.

Stainless steel components may be substituted where galvanizing is specified.

LOCATOR RIBBON:

As specified in Section 02320, TRENCH BACKFILL.

INSULATION:

Piping:

Riser Pipes:

Rigid fiberglass insulation wrapped with factory-applied, kraft reinforced vapor barrier jacket with pressure-sensitive, self-sealing lap, UL rated, 1-1/2 inches thick.

Circumferential Joints: Matching pressure-sensitive butt strips.

Manufacturers and Products:

Owens-Corning; Fiberglass ASJ/SSL-11.

Manville; Micro-Lok 650 with AP-T jacket.

Combined Sump (Riser Pipes Only):

Material: Flexible elastomeric pipe insulation, closed cell structure, 3/4 inch thick.

Temperature Rating: Minus 40 degrees F to 180 degrees F.

Nominal Density: 6 pcf.

Conductivity in accordance with ASHRAE 90.1 and minimum of 0.27 BTU-in/hr-ft^2 degrees F at 75 degrees F per ASTM C177 or ASTM C518.

Minimum water vapor transmission of 0.10 perm-inch per ASTM E96.

Seal joints with manufacturer's adhesive.

Flame Spread Rating: Less than 25 per ASTM E84.

Manufacturers and Products:

Rubatex; R-180-FS.

Armstrong; Armaflex AP.

Piping and Insulation Cover: Aluminum jacket 0.016-inch thick.

PART 3--EXECUTION

EXAMINATION:

Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

PREPARATION:

Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

INSTALLATION-GENERAL:

Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

Remove foreign objects prior to assembly and installation.

Flanged Joints:

Install perpendicular to pipe centerline.

Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.

Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.

Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.

Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.

Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.

Threaded flanged joints must be shop fabricated and delivered to jobsite with flanges in-place and properly faced.

Threaded and Coupled Joints:

Conform with ANSI B1.20.1.

Produce sufficient thread length to ensure full engagement when screwed home in fittings.

Countersink pipe ends, ream and clean chips and burrs after threading.

Make connections with not more than three threads exposed.

Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

High Density Polyethylene Piping: As specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

INSTALLATION-EXPOSED PIPING:

Piping Runs:

Parallel to building or column lines and perpendicular to floor, unless shown otherwise.

Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

Piping Clearance (unless otherwise shown):

Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet 0 inches, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

From Adjacent Work: Minimum 1 inch from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.

Head room in front of openings, doors, and windows shall not be less than the top of the opening.

Do not install piping containing liquids or liquid vapors in transformer vaults.

Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

INSTALLATION-DOUBLE WALL CONTAINMENT PIPING SYSTEM:

Install as specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

INSTALLATION-BURIED PIPE:

Placement: In accordance with Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

INSTALLATION-BURIED GASKETED PIPE:

Install fire protection piping and gasketed raw water piping in accordance with Section 15505, UNDERGROUND FIRE PROTECTION PIPING.

THRUST RESTRAINT:

Location: At pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist.

Type: Thrust blocks. Use joint restraint where shown, or otherwise required or approved.

Thrust Blocking:

Install in accordance with Section 15505, UNDERGROUND FIRE PROTECTION PIPING, and as detailed on the Drawings.

Place blocking so that pipe and fitting joints will be accessible for repairs.

Place concrete in accordance with Section 03301, CONCRETE.

SLAB, FLOOR, WALL, AND ROOF PENETRATIONS:

Application and Installation: As shown on Drawings.

Wall Pipe Installation: Support wall pipes securely by framework to prevent contact with reinforcing steel and tie wires.

BRANCH CONNECTIONS:

Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including the first block valve in the line carrying the lower pressure, unless otherwise shown.

Threaded Pipe Tap Connections:

Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.

Limitations: Threaded taps in pipe barrel are unacceptable.

VENTS AND DRAINS:

Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines at all low and high point locations. VENTS AND DRAINS ARE NOT SHOWN ON DRAWINGS.

CLEANING:

Following assembly and testing, and prior to final acceptance, flush pipelines (except as stated below) with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

If impractical to flush large diameter pipe at 2.5 fps, clean in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.

Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

FIELD FINISHING:

Notify BBWI Construction Manager at least 3 days prior to start of any surface preparation or coating application work.

LOCATOR RIBBON:

Locator ribbon shall be installed as specified in Section 02320, TRENCH BACKFILL.

PIPE IDENTIFICATION:

Buried Piping:

Identification Ribbon: Underground pipelines shall be identified by use of a plastic ribbon or stencil no less than 3 inches in width with a message printed on the ribbon which identifies the actual pipeline contents. Marking tapes or stencils shall be placed on existing lines where they are exposed by trenching operations. The ribbon shall be wrapped around the pipeline at no less than 1 wrap per 3 feet of run. The plastic ribbon/stencil shall be color coded in accordance with the Piping Schedule and INEEL Guide Specifications.

Exposed Piping:

In general, all exposed piping shall be color coded and identified in accordance with ANSI A-13-1. It is the intent of this standard that the identification method of aboveground piping is by English text that allows the contents to be readily identified. Flow direction should be also shown by arrows.

All piping and equipment shall be identified in accordance with established site standards. Piping identification legends and symbols shall conform to the appropriate drawing listed in Appendix D of the AE Standards.

In addition to the requirements specified herein, all pipelines and standard equipment shall be color coded and identified according to Appendix M of the AE Standards and shall be tagged with beaded chain or steel cable stainless steel tags displaying the pipe or equipment number as shown on the drawings. The tags shall be fabricated from 300 series austenitic stainless steel metal strips 3/4 inches wide, 24-gauge minimum thickness, with 3/16-inch high letters stamped on the metal surface. Tagging for pipe shall be done at approximately 20-foot intervals with at least one tag in each room. Any pipes entering or leaving a room shall be tagged on each side of the wall. The tags shall be attached to the pipe or austenitic equipment with austenitic stainless steel bead chain or austenitic stainless steel cable. When tagging valves, the bead chain shall be attached to the valve stem or yoke.

LEAKAGE TESTING:

As specified in Section 15992, PIPING LEAKAGE TESTING.

SUPPLEMENTS:

Supplement 1—Polyvinyl Chloride (PVC) Pipe and Fittings.

Supplement 2—Galvanized Steel Pipe and Malleable Iron Fittings.

Supplement 3—Piping Schedule.

END OF SECTION 15060

POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

Item	Size	Description
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with 2 percent titanium dioxide for ultraviolet protection. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket-weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with 2 percent titanium dioxide for ultraviolet protection.
Joints	All	Solvent socket-weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One piece, molded hub type PVC flat face flange in accordance with Fittings above, 125-pound ANSI B16.1 drilling
Bolting	All	ASTM A193/A193M Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/ A194M Grade 8M hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch thick ethylene propylene (EPR) rubber. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	As recommended by the pipe and fitting manufacturer conforming to ASTM D2564.
Thread Lubricant	All	Teflon Tape.

GALVANIZED STEEL PIPE AND MALLEABLE IRON FITTINGS

Item	Size	Description
Pipe		Galvanized carbon steel, ASTM A106, Grade B seamless or ASTM A53, Grade B seamless or ERW.
	2" and smaller	Schedule 80.
	2-1/2" through 6"	Schedule 40.
Joints	All	Threaded or flanged at valves and equipment.
Fittings		Threaded: 150- or 300-pound galvanized malleable iron, ASTM A197 or ASTM A47, dimensions in accordance with ANSI B16.3.
Flanges		Galvanized forged carbon steel, ASTM A105/A105M, ANSI B16.5 Class 150 or Class 300, threaded, 1/16-inch raised face.
Unions		Threaded malleable iron, ASTM A197 or A47, 300-pound WOG, brass to iron seat, meeting the requirements of ANSI B16.3.
Bolting		Flanges: Carbon steel ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.
Gaskets	All flanges	Flanged, Water and Sewage Service: 1/8 inch thick, red rubber (SBR), hardness 80 (Shore A), rated to 200 degrees F, conforming to ANSI B16.21, AWWA C207, and ASTM D1330, Grades 1 and 2.
Thread Lubricant	2" & smaller	Teflon tape or joint compound that is insoluble in water.

PIPING SCHEDULE LEGEND

SERVICE

FW	Fire Protection Water
RW	Raw Water
LCRS	Leachate Collection Recovery System
LDRS	Leak Detection Recovery System
D	Drain
SPD	Sump Pump Discharge
SW	Service Waste

EXPOSURE

BUR	Buried
EXP	Exposed
SUB	Submerged

MATERIAL

CLDI	Cement-Lined Ductile Iron
DI	Ductile Iron
GSP	Galvanized Steel Pipe
HDPE	High Density Polyethylene
PVC	Polyvinyl Chloride
SST	Stainless Steel
STL	Steel

PRESSURE TEST

H	Hydrostatic
I	In Service
P	Pneumatic
NA	Not Applicable

JOINT TYPE

BF	Butt Fused
FL	Flanged
PO	Push-on
SW	Solvent Weld
TH	Threaded

PIPING SCHEDULE

Service Code	Service	Size(s) (In.)	Exposure	Piping Material	Joint Type	Specification Section	Design Pressure (psig)	Test Type	Test Pressure	Pipe Colors and Labels	Applicable Code	Remarks
FW	FW	≥4″	BUR	PVC	PO	15505	175	H	225 Per 15505	Red/White	NFPA 24, FM3-10	
RW	RW	≥4″	BUR	PVC	PO	15060, 15505	80-100	H	150	Green/White	ASME B31.3, FLUID D	
RW	RW	≤2″	BUR	PVC	SW,FL,TH	15060	80-100	H	150	Green/White	ASME B31.3, FLUID D	
RW	RW	≤2″	EXP	GSP	TH	15060, 15505	80-100	H	150	Green/White	ASME B31.3, FLUID D	Service to hose bibbs
SW	SW	All	BUR	HDPE	BF	15021	80-100	H/P	150/4*	Green/White	ASME B31.3, FLUID D	SDR 17
SW	SW	All	EXP	PVC	FL,SW,TH	15060	80-100	H	150	Green/White	ASME B31.3, FLUID D	
SW	LCRS	All	BUR	HDPE	BF	15021	65	H/P	150/4*	Green/White	ASME B31.3, FLUID D	SDR 17, except SDR 11 within landfill cell
SW	LCRS	All	EXP	PVC	SW,FL,TH	15060	65	H	150	Green/White	ASME B31.3, FLUID D	Except cleanouts are HDPE
SW	LDRS	All	BUR	HDPE	BF	15021	65	H/P	150/4*	Green/White	ASME B31.3, FLUID D	SDR 17, except SDR 11 within landfill cell
SW	LDRS	All	EXP	PVC	SW,FL,TH	15060	65	H	150	Green/White	ASME B31.3, FLUID D	
SW	D	All	BUR	HDPE	BF	15021	atm	H	4*	Green/White	ASME B31.3, FLUID D	SDR 17
SW	SPD	All	BUR	HDPE	BF	15021	20	H	30/4*	Green/White	ASME B31.3, FLUID D	SDR 17
SW	SPD	All	EXP	PVC	SW, FL, TH	15060	20	H	30	Green/White	ASME B31.3, FLUID D	

*Double Containment Piping: Carrier pipe tested at the higher pressure; containment pipe tested at the lower pressure except for drains.

SECTION 15100--VALVES AND OPERATORS

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AMERICAN SOCIETY OF SANITARY ENGINEERS (ASSE)

ASSE 1011	Performance Requirements for Hose Connections Vacuum Breakers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A276	Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A351	Standard Specification for Castings, Austenitic, Austenitic-Ferric (Duplex), for Pressure-Containing Parts
ASTM B61	Standard Specification for Steam or Valve Bronze Castings
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B98	Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B127	Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
ASTM B139	Standard Specification for Phosphor Bronze Rod, Bar, and Shapes
ASTM B164	Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B194	Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM D429	Test Methods for Rubber Property—Adhesion to Rigid Substrates
ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500	Gate Valves for Water and Sewerage Systems
AWWA C504	Standard for Rubber-Seated Butterfly Valves.
AWWA C508	Standard for Swing-Check Valves for Waterworks Service, 2 in. Through 24 in. NPS
AWWA C509	Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C510	Double Check Valve, Backflow-Preventer Assembly
AWWA C511	Required Pressure Backflow-Prevention Assembly
AWWA C540	Power-Actuating Devices for Valves and Sluice Gates
AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
AWWA C606	Grooved and Shouldered Joints
AWWA C800	Underground Service Line Valves and Fittings

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

MSS SP	Stainless Steel, Bonnetless, Flanged Knife Gate Valves
MSS SP	Diaphragm Type Valves

PART 2--PRODUCTS

GENERAL:

Valve to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and accessories for a complete operation.

Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

Valve same size as adjoining pipe.

Valve ends to suit adjacent piping.

Size operator to operate valve for the full range of pressures and velocities.

Valve to open by turning counterclockwise.

Factory mount operator, actuator, and accessories.

MATERIALS:

Brass and bronze valve components and accessories that have surfaces in contact with liquids other than leachate to be alloys containing less than 16 percent zinc and 2 percent aluminum. Valves in service on leachate lines shall have no bronze, brass, or copper wetted parts.

Approved alloys are of the following ASTM designations:

B61, B62, B98 (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.

Stainless steel Alloy 18-8 may be substituted for bronze.

FACTORY FINISHING:

Exposed Valves:

Manufacturer's standard corrosion-resistant coating suitable for intended service.

Safety isolation valves and lockout valves with handles, handwheels, or chain wheels "safety yellow."

VALVES:

Gate Valves:

Type V128 Gate Valve 3 Inches and Larger for Buried High Pressure Water Service: Iron body, bronze mounted, mechanical joint, flanged, or other approved ends, double disc gate, nonrising bronze stem, O-ring sealed stuffing box, 2-inch square wrench nut conforming to AWWA C500, rated 250 psi nonshock cold water. Valve shall be UL listed or FM approved for fire protection service, as necessary.

Manufacturers and Products:

Clow: Model F-5707, or equal.

Type V130 Resilient Seated Gate Valve, 3 Inches to 20 Inches: Building Sump Drain Valve.

Iron body, resilient seat, bronze mounted, flanged ends, nonrising stem, 2-inch operating nut, in accordance with AWWA C509, design working water pressure 200 psi for 2 inches through 12 inches and 150 psi for 16 inches and 20 inches, full port, fusion-epoxy coated inside and outside.

Coating to meet requirements of AWWA C550.

Manufacturers:

American AVK.

M & H.

Clow.

Mueller.

U.S. Pipe.

Ball Valves:

Type V330 PVC Ball Valve 2 Inches and Smaller: Rated 150 psi at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Viton or Teflon O-ring stem seals, to block flow in both directions.

Manufacturers and Products:

Nibco; True-Bloc.

ASAHI America; Duo-Bloc.

Type V331 PVC Ball Valve 3 and 4 Inches: Rated 150 psi at 73 degrees F, with ASTM D1784 Type I, Grade 1 polyvinyl chloride full port body, Teflon seat, Viton O-ring stem, face and carrier seals, end entry design with dual union, solvent-weld socket ends, or single union ball valve with flanged ends drilled to ANSI B16.1.

Manufacturers and Products:

Nibco.

ASAHI America.

Check and Flap Valve:

Type V609 PVC Swing Check Valve 4 Inches and Smaller: ASTM D1784, Type I, Grade 1, PVC body, rated at 150 psi, Viton seats and seals, flanged ends.

Manufacturer: ASAHI America.

Self-Contained Automatic Valves:

Type V740 Air and Vacuum Valve 1/2 Inch to 16 Inches:

1/2-inch through 3-inch NPT inlets and outlets, 4 inch and larger ANSI B16.1 flanged inlet with plain outlet and protective hoods.

Rated 150 psi working pressure, cast iron, ductile iron, or semi-steel body, cover with stainless steel float and trim.

Manufacturers and Products:

APCO Valve and Primer Corp.; Series 140.

Val-Matic Valve; Series 100.

Miscellaneous Valves:

HV-1, Hose Valve:

Cast bronze angle pattern valve, 1-1/2-inch size, with NPT screwed ends, union bonnet, rising stem, teflon disc, hand wheel, and NPT x NST hose thread adapter outlet connection.

Rated 150-pound service water pressure, 300-pound WOG.

Manufacturers and Products:

Stockham; Figure B-222T.

OPERATORS:

Manual Operator:

General:

Operator force not to exceed 40 pounds under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 40 pounds.

Operator self-locking type or equipped with self-locking device.

Position indicator on quarter-turn valves.

Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threader steel reach rods with internally threaded bronze or ductile iron nut.

Exposed Operator:

Galvanized and painted handwheels.

Lever operators allowed on quarter-turn valves 8 inches and smaller.

Valve handles to take a padlock, and wheels a chain and padlock.

Buried Operator:

Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.

Design buried service operators for quarter-turn valves to withstand 450 foot-pounds of input torque at the FULLY OPEN or FULLY CLOSED positions, grease packed and gasketed to withstand a submersion in water to 10 psi.

Buried valves shall have extension stems, bonnets, and valve boxes.

ACCESSORIES:

T-Handled Operating Wrench:

Two each galvanized operating wrenches, 4 feet long.

Manufacturers and Products:

Mueller; No. A-24610.

Clow No.; F-2520.

Two each galvanized operating keys for cross-handled valves.

Extension Bonnet for Valve Operator: Complete with stem and accessories for valve and operator.

Manufacturers:

Pratt.

Allis-Chalmers.

Cast Iron Valve Box: Designed for traffic loads, sliding type, with minimum of 6-inch ID shaft.

Box: Cast iron with minimum depth of 9 inches.

Lid: Cast iron, minimum depth 3 inches, marked WATER.

Extensions: Cast iron.

PART 3--EXECUTION

INSTALLATION:

Flange Ends:

Flanged valve boltholes shall straddle vertical centerline of pipe.

Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

Screwed Ends:

Clean threads by wire brushing or swabbing.

Apply joint compound.

Valve Orientation:

Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.

Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above finish floor, unless otherwise shown.

Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

Extension Stem for Operator: Where the depth of the valve is such that its centerline is more than 3 feet below grade, furnish an operating extension stem with 2-inch operating nut to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover, unless otherwise shown.

END OF SECTION